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Respons of Early Growth Vetiver *(Vetiveria Zizanioides* L.*)* Seedling on Salt Stress Condition

Respon Pertumbuhan Awal Bibit Vetiver (Vetiveria zizanioides L.) Pada Kondisi Cekaman Salinitas

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ABSTRACT

Vetiver (Vetiveria zizanioides) is one of the essential oil-producing plants which is commonly called vetiver oil. Agricultural land in Indonesia has a salinity problem estimated at 0.44 million ha, the increase in salinity of agricultural land threatens the stability of agricultural production. This study aims to determine the respons of early growth vetiver (Vetiveria zizanioides L.) seedlings on salt stress condition. This research was conducted in a greenhouse, Faculty of Agriculture, Universitas Sumatera Utara, Medan. This study used a non-factorial randomized block design (RBD), namely the salinity (S) which consisted of 3 factors: the EC salinity levels were 0 (distilled water), 4 and 8 ds / m. The salinity stress treatment showed a significant effect of reducing the growth parameters of leaf dry weight, number of stomata and cuticle thickness but did not significantly affect the specific leaf area parameters at 8 WAP. The salinity stress treatment gave significantly better effect in conditions without salinity stress and partly showed better results in the salinity stress condition at the level of 8 dsm^{-1}.

Keywords: *Salinity, Vetiveria zizanioides, early growth, seed, vetiver oil.*

ABSTRAK

Akar wangi (Vetiveria zizanioides) merupakan salah satu tanaman penghasil minyak esensial yang disebut minyak vetiver. Lahan pertanian di Indonesua memiliki masalah salinitas diperkirakan 0,44 juta ha, peningkatan cekaman salinitas pada lahan pertanian mempengaruhi produksi pertanian. Penelitian ini bertujuan untuk mengetahui respon pertumbuhan awal bibit vetiver (Vetiveria zizanioides L.) pada kondisi cekaman salinitas. Penelitian ini dilaksanakan di rumah kaca Fakultas Pertanian Universitas Sumatera Utara, Medan. Penelitian ini menggunakan Rancangan Acak Kelompok (RAK) non faktorial, yaitu cekaman salinitas (S) yang terdiri dari 3 faktor: tingkat salinitas EC sebesar 0 (air suling), 4 dan 8 ds/m. Perlakuan cekaman salinitas memperlihatkan pengaruh nyata menurunkan pada parameter pertumbuhan berat kering daun, jumlah stomata dan tebal kutikula namun tidak berpengaruh nyata terhadap parameter luas daun spesifik umur 8 MST. Perlakuan cekaman salinitas memberikan pengaruh nyata lebih baik pada kondisi *tanpa* cekaman salinitas dan sebagian menunjukkan hasil lebih baik pada kondisi cekaman salinitas pada tingkat 8 dsm^{-1}.

Kata Kunci: Salinitas, *Vetiveria zizanioides*, pertumbuhan awal, benih, minyak vetiver.

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INTRODUCTION

Vetiver grass (*Vetiveria zizanioides*) is one of the essential oil-producing plants commonly called vetiver oil, as a manufacture of perfumes, cosmetics, soap scents, medicines, and insect repellent and insect repellent (Ghotbizadeh and Sepaskhah. 2015). The content of essential oils is 1.6 + 0.52% and vetivoral content is 50.38 + 1.41% (BPT Obat and Rempah, 2017).

Agricultural land in Indonesia has an estimated salinity problem of 0.44 million ha (Purwaningrahayu and Abdullah, 2018). Saline soil has a pH between 7-8.5, this is because the excess Na + ions make soil particles suspended permanently so that soil permeability is inhibited and soil osmotic pressure increases. This stress causes plasmolysis, which is the release of H2O from plant cells. Plasmolisism causes roots to be inhibited from absorbing water and nutrients, leading to the death of plant cells and tissues (Tolib et al. 2017). Salinity describes the increasing concentration of salt ions in soil and water such as calcium (Ca2 +), magnesium (Mg2 +), potassium (K +), chloride (Cl-), bicarbonate (HCO3-), carbonate (CO32-), and sulfate (SO42). Salinity stress reduces plant growth due to osmotic water stress, high levels of Na and Cl ion poisoning, nutrient imbalance due to high levels of Na + and Cl- which inhibits absorption of K +, NO-, PO43-, and an increase in damaging ROS (reactive oxygen species) macro molecules (Kristiono et al. 2013).

Seed development is the stage most sensitive to abiotic stress (Mohammadizad et al. 2013). Plants that experience salt stress will generally have suppressed growth and change slowly (Sugiharto et al. 2017). Soil salinity will inhibit the formation of new roots so that the roots are difficult to absorb water due to the high osmosis of soil solution which will cause dryness in plants. Therefore, the development of salt-tolerant varieties has been considered as one strategy to increase production (Arzie et al. 2015).

Plants that contain salt can synthesize antioxidants in cells such as superoxide dismutase (SOD), catalase (CAT) and various peroxidases (POD) as uptake of reactive oxygen species (ROS) (Wang et al. 2014). Although vetiver is widespread in saline areas, only a few studies have reported that they are sufficiently tolerant of salt and the basic mechanism of salt tolerance in vetiver is still not known for certain (Cuong et al. 2015; Zhouand Yu. 2009). Based on this, it is deemed necessary to conduct research on the effect of salinity stress on the initial growth of vetiver seedlings.

MATERIALS AND METHOD

To determine the effect of salinity stress on early growth of vetiver (*Vetiveria zizanioides*) seedlings. Experiments have been carried out in the greenhouse of the Faculty of Agriculture, Universitas Sumatera Utara. Starting from March to May 2019. The research used a non-factorial Completely Randomized Design, namely the salinity stress (S) which consisted of 3 factors: the EC salinity level was 0 ds / m (aquadest), 4 ds / m and 8 ds / m. If the effect of the treatment is significantly different on variance, then a further test is carried out using Duncan's Multiple Range Test.

Land Preparation. The land is cleaned until it is clean. The first treatment, polybags filled with top soil. The second treatment, polybags filled with saline soil (4 dsm-1). The third treatment, polybags filled with saline soil (8 dsm-1).

Ordering seeds. The seeds used in this study came from 6 months old vetiver seeds in Bogor Regency.

Preparation of Seeds. The seeds of vetiver were taken with uniform growth,

not attacked by pests and diseases. A marker label is placed on each plot of the plant.

Salinity Treatment. To apply the salinity treatment, saline soil was looked for, the salinity level was measured by a digital refractometer. Adjusted to the predetermined salinity level so that the salinity levels are 0ds / m (distilled water), 4 ds / m and 8 ds / m.

Planting Seeds. The sorted seedlings with uniform growth were planted according to their respective treatments.

Maintenance carried out:

Sprinkling. Seedlings are watered with sufficient distilled water (if needed), watering for saline soil is watered using salt treated water with a salinity concentration according to each treatment, namely 0ds / m (distilled water), 4 ds / m and 8 ds / m.

Weeding. Performed at intervals of 1 week by pulling out weeds in the poly bag.

Pest and Disease Control. Pests are controlled manually by being taken directly from vetiver plants. Plants attacked by disease are treated by spraying the insecticide with the trademark Sandor 30 WP and plants that have been badly damaged are replaced with new plants or removed.

Parameters observed:

Leaf Dry Weight. Dry weight testing was carried out by oven drying at a temperature of 65oC until the sample plant weight was constant.

Specific Leaf Areas. Specific leaf area is the area of the leaf per unit dry weight of the leaf. Specific leaf area analysis was carried out at the Basic Laboratory, Faculty of Agriculture, Muhammadiyah University of North Sumatra, Medan.

Number of Stomata. Observation of the number of stomata was carried out using a microscope at the age of 10 MST in the Basic Laboratory, Faculty of Agriculture, Muhammadiyah University of Sumatera Utara, Medan.

Cuticles Thickness. Cuticle thickness observations were carried out using the Carl Zeiss Primo Star microscop compound, at the age of 8 MST at the Integrated Laboratory, Faculty of Medicine, University of Sumareta Utara, Medan.

RESULTS AND DISCUSSION

The application of salinity had a very significant effect on the average dry weight of the leaves (Table). Treatment without salinity (S0) increases the dry weight of leaves compared to giving salinity of 4 dsm-1 (S1) and 8 dsm-1 (S2). The increase in salt concentration in the soil is one of the environmental stress factors. The large amount of soil salt content occurs due to two things, namely due to the high intake of water containing salt or experiencing an evaporation rate that exceeds the precipitation.

The dominant salt in such land is sodium chloride (NaCl). On a basic level, the plant response to salinity can be described in two main phases: the ion-independent firing response occurs first, within minutes to days, and is thought to be associated with Na sensing and signaling. In this first phase, the effect of salinity on the water relationship becomes important, causing closure of the stomata and inhibiting leaf development. The second phase, the ion response depends on salinity, develops over a longer period (days to weeks) and involves the build-up of ions in shooting for toxic concentrations, especially in old leaves, causing premature aging of the leaves and ultimately reducing yields or even dying plants.

Giving salinity had no significant effect on specific leaf area (Table). The salinity gave a significant effect on the average number of stomata (Table). Treatment without salinity (S0) increased the number of stomata compared to giving 4 dsm-1 (S1) and 8

dsm-1 (S2) salinity. The increase in salt concentration in the soil is one of the environmental stress factors. The large amount of soil salt content occurs due to two things, namely due to the high intake of water containing salt or experiencing an evaporation rate that exceeds the precipitation.

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Stomata size and density are closely related to the resistance of varieties to salinity stress. Plants will experience a decrease in the number of stomata to reduce water loss during respiration (Hidayati et al. 2017).

The salinity gave a significant effect on the mean cuticle thickness (Table). Treatment without salinity (S0) increased cuticle thickness compared to administration of 4 dsm-1 (S1) and 8 dsm-1 (S2) salinity. This is because plants that are in a high salinity stress condition adapt to the existing cuticles on the leaves, where the leaf area is narrowed but the cuticles thicken so that the plant can survive in conditions of high salt stress. This is in line with the results of research by Busaifi (2017), which states that plants adapt to stress by increasing leaf thickness, because the thicker layer of culture can inhibit water loss.

The results of research by Sobil et al. (2018), that the higher the concentration of salinity will increase the thickness of the culture, but there will be changes in the number and shape of morphology in plants. Plant growth occurs due to disruption of the water and nutrient transportation system so that the rate of photosynthesis decreases excessively due to salt uptake.

Table. Leaf dry weight, specific leaf area, number of stomata and thick cuticles in salinity stress treatment.

Treatment	Leaf Dry Weight (g)	Specific Leaf Area (cm g^{-1})	Number of Stomata (mm^2)	Cuticles Thickness (µm)
Salinity Stress				
S0 (0 ds/m)	2,14a	10,72	220,00a	48,03a
S1 (4 ds/m)	1,78b	10,18	164,67b	76,84b
S2 (8 ds/m)	1,57c	10,06	152,00b	80,02

The numbers in the same column and row followed by the same letter are not significantly different at the 5% level based on the LSD test

CONCLUSION

The salinity stress treatment showed a significant effect on reducing the initial growth of vetiver (*Vetiveria zizanioides*) seedlings on the growth parameters of leaf dry weight, number of stomata and culture thickness but had no significant effect on specific leaf area parameters.

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